

METAL CASTING

Project Fact Sheet



OPTIMIZATION OF THE SQUEEZE CASTING PROCESS FOR ALUMINUM ALLOY PARTS

BENEFITS

By improving the squeeze casting process, new options will be available to the casting industry for producing the complex, light weight aluminum parts that are increasingly demanded in competitive markets such as that for automotive components. This will result in melting-related energy savings due to the lower melt temperature for aluminum versus alternative metals. Improving current knowledge of the squeeze casting process also will reduce scrap by an estimated 15%. In addition, a significant reduction in solid waste and dust will result from conversion to the squeeze casting process. Total annual energy savings by 2020 are estimated to be 428 billion Btu.

APPLICATIONS

The results of this project can be applied throughout the die casting industry. With an improved understanding of squeeze casting, there will be greater opportunity for adoption of the process among the die casting community.

FUNDAMENTAL PRINCIPLES APPLIED TO NEW CASTING PROCESS

Squeeze casting is a relatively new and developing casting process. It is suitable for high strength, high ductility, lightweight structural aluminum castings needed for advanced components. A major market is the automotive market which is increasingly demanding lightweight components to improve fuel efficiency. Because squeeze casting is relatively new, much work needs to be done to better understand the fundamentals of the process. In particular, the relationships between the design, the processing parameters, and the integrity of the squeeze cast parts are still not well understood. In the absence of well established guidelines, the penetration of this process has been slow.

In this project, Case Western Reserve University and industry partners are applying fundamental heat and mass transfer principles to the squeeze casting process. Experimental work is being performed on an industrial-scale 350 metric ton squeeze caster. Computer simulations of metal flow and solidification will be conducted. This investigation is designed to show the control needed of the different variables to improve the quality of the squeeze casting process. The variables that were determined to be significant were the die temperature, the design of the gates to control the squeeze pressure applied to the molten aluminum alloy as it fills the mold.

The results of the project will be used to develop detailed guidelines for the design and squeeze cast components and the dies for manufacturing them. Research results are being disseminated to industry through conferences and other forums. Final guidelines will similarly be disseminated to industry.

OPTIMIZATION OF SQUEEZE CASTING



UBE 350 ton squeeze casting machine at Case Western Reserve University.



Project Description

Goal: The goal of this project is to apply fundamental heat and mass transfer principles to the squeeze casting process in order to optimize processing variables. The results of this project, disseminated to industry, will help to improve the quality of the castings manufactured using the squeeze casting process.

Progress and Milestones

This three year project was awarded in 1998. Specific objectives are to:

- Conduct a detailed experimental study of metal flow and heat transfer in the squeeze casting process.
- Analyze the relationships between the design of the part, the squeeze casting system, the processing variables, and the soundness of the squeeze cast part.
- Generate an integrated flow-heat transfer computer model for design of squeeze castings.
- Provide detailed guidelines for the design of squeeze cast components and the dies for manufacturing them.
- Demonstrate implementation of the design guidelines and computer model in the production of sound, high strength, aluminum components.

One important interim conclusion is that, if the gate is too small, the metal in the gate freezes before the squeeze (intensification) pressure is applied, and the solidification shrinkage is not eliminated.

The results of this study have been now presented to the 1999 North American Die Casting Association and 2000 Technical Procedures to 300 people in Cleveland and in Chicago. The proper control of this process requires that these process variables be properly controlled to produce good quality squeeze cast parts.



PROJECT PARTNERS

Case Western Reserve University
Cleveland, OH

North American Die Casting Association
Rosemont, IL

Blaze Technical Sensors, Stowe, OH

DCD Technologies, Cleveland, OH

Euclid Heat Treat, Cleveland, OH

Ford Motor Company, Dearborn, MI

Hayes-Lemmerz-CMI, Ferndale, MI

ITT Automotive, Cleveland, OH

Latrobe Steel Company, Latrobe, PA

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